

Niels Steensen and his contributions to crystal growth and crystallography

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Danish scientist and bishop Niels Steensen was born in Copenhagen in 1638. His family expected him to take over the business of his father, a goldsmith, but Steensen entered the University of Copenhagen to pursue the medical studies. As a student he began, in accordance with the academic customs of his time, to use Latin name Nicolaus Stenonis. The commonly used name Steno is probably an incorrect derivation from this [1]. Steensen is considered to be one of the last polymaths, i.e. scientists who focused on a wide range of scientific disciplines. His research deals not only with medicine and anatomy, but also with geology, crystallography, crystal growth and other natural sciences. Steensen's contribution to science is of a great importance. In the first place he suggested a modern approach to the natural sciences. In his early work, so called *Chaos - manuscript*, Steensen criticizes the contemporary state of the natural sciences as too conservative, related to the ancient authors and the Bible and closed to scientific progress. According to Steensen science must be based on logic and individual research made with accuracy and precision. His motto was: "Experimental exactitude, reproducible results". Steensen's contribution to crystal growth and crystallography was published in his geological studies *De solido intra solidum naturaliter contento dissertationis prodromus (Preliminary discourse to a dissertation on a solid body naturally contained within a solid)* in 1669. Steensen's observations concerning crystals are impressive, if we realize that he made them in the time, when no analytical methods were used. He has recognized, that crystals do not grow from "inside" like flowers and other living organisms, but from "outside" as a result of material deposition on the surface of the existing crystal. He has also disproved a common belief that all crystals were made from ice, and divided crystals into different groups according to parent material. It was also Steensen, who first discovered that the interfacial angles of quartz crystals were the same regardless of the size or shape of the crystal [2]. This principle was later named after him and has been known as Steno's law or Steno's law of constant angles. The last Steensen's conclusion of great importance relates to the reciprocity of crystal growth and its dissolution. It took over 300 years before modern research on the crystal growth confirmed these observations [3].

The author would like to thank to Dr. Nitsch and Mr. Král for the skilful assistance.

- [1] I. H. Porter. *Thomas Bartholin (1616-80) and Niels Steensen (1638-86) Master and Pupil*. Med Hist. 7 (2) (1963)
- [2] Lecture 1 - Earth Materials, http://darkwing.uoregon.edu/cashman/GEO311/311pages/L1-Intro_pic.htm
- [3] H. Kermit. *Niels Stensen, 1638–1686: The Scientist Who Was Beatified*. Leominster, UK: Gracewing. 2003